Gas Laboratory Analysis System for EPA/NVFEL

Statement of Work

DRAFT

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1.0   Overview and General Requirements

Sections 1.1 through 1.8 provide an overview of the scope of the project and general requirements of the equipment being procured. Specific references, which provide important technical information or guidance, are listed in Section 1.1. Where noted, the requirements of some documents are incorporated by reference as requirements of this Statement of Work.

Background information relating to the procurement is found in Section 1.2. A general description of the equipment covered by this Statement of Work, and associated requirements, are presented in Section 1.3. Other general requirements are covered in the balance of Section 1, including requirements for project management.

Contract deliverables and specific requirements are addressed in detail in subsequent sections of the Statement of Work. Instructions relating to constructing responsive contractor proposals, and information regarding the technical evaluation of proposals related to this procurement by EPA, are found in other Attachments to the Request for Proposal.

Definitions of the acronyms used in this document are provided in the Appendix A.

1.1   References

All references shall be the most current available as of the date of this contract solicitation.

1.1.1   Code of Federal Regulations 40 CFR, Subchapter C, Part 86 "Control of Emissions From New and In-Use Highway Vehicles and Engines," Subparts B, M, N, R, S

1.1.2   Code of Federal Regulations 29 CFR Part 1910 "Occupational Safety and Health Standards"

All CFR materials may be found at http://www.access.gpo.gov/ecfr/

**1.1.3   ISO 17025 - General Requirements for the Competence of Testing and Calibration Laboratories
http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=30239**

1.1.4   **NFPA 70, National Electrical Code**
            (http://www.nfpa.org)

1.1.5   **NVFEL Preparation of Gravimetric Binary Gas Mixtures**
            (http://www.epa.gov/otaq/labtechnique.htm)

1.1.6   **EPA Traceability Protocol for Assay and Certification of Gaseous Calibration**
            Standards. (see "EpaProtocol.pdf)*
            * *This copy of the protocol is provided for reference to this Statement of Work and*
            does not contain Section 3 of the protocol, which is not pertinent to this project.

1.1.7   **The following 3 documents are included in an Acrobat file named: NVFEL**
            procedures.pdf.. These are outdated procedures included for enhancing
            understanding of the historical path. These procedures have not been updated, but
            current practice has moved beyond what is described here. Our intent is to move
            even farther up in technical level.

            (a)   NVFEL Gas Naming Procedure

            (b)   NVFEL Span Point Change Notice Procedure

            (c)   NVFEL Gas Correlation Procedure

1.2   **Background and Procurement Overview**

1.2.1   **As part of the Clean Air Act and its Amendments, a variety of new emissions**
            regulations have been implemented for vehicles and engines. Tier 2 and the 2007
            Diesel rule are two examples of regulations that require sophisticated and adaptable
            emission measurement systems. The EPA National Vehicle and Fuels Emissions
            Laboratory (NVFEL) has undertaken a comprehensive program to implement new
            and refined test systems to enhance the capabilities to conduct low level emissions
            testing, of the highest precision and accuracy, on a broad range of vehicles and
            engines.

            In its role as a National Laboratory for the measurement of regulated emissions, and
            energy consumption, related to the transportation sector, NVFEL plays a critical
            role in the standardization of those measurements. To support that role, EPA seeks
            to purchase a combined analytical, data acquisition, analysis and reporting system to
            aid in establishing, and documenting the official concentration and NIST traceability,
            of internal gas standards and challenge standards.

1.2.2 **For the equipment specified, the contractor shall have total system responsibility, which shall include all phases of the project, design/configuration, assembly, integration, quality assurance, delivery to EPA-NVFEL, installation, calibration, commissioning, acceptance testing, documentation and training of EPA staff. The contractor shall be responsible for documenting measurement system traceability and system acceptance in a manner suitable for audit to ISO standards.**

1.3 **General Description of the GLAS.**

1.3.1 **The GLAS shall include specific gas analyzers that provide the highest levels of precision and accuracy available for the intended purpose, configured as detailed in subsequent sections of this Statement of Work. In addition the system will include a computer system for analysis control, data acquisition and information processing, equipped with a standard color laser printer, and bar code reader for rapid identification and verification of cylinder identifications. The computer system shall control operation of the analysis bench, aid in the quality control of the gas naming process, collect and store measurement data as necessary. The database that resides on the GLAS computer is in part composed of the information that it will receive from the IFC to support curve generation and naming. The GLAS will make its results available to the IFC for updating the NVFEL gas cylinder database.**

1.3.2 **The GLAS shall interface with the LNS via an EPA-provided Interface Computer (IFC) as described in Appendix C.**

1.3.3 **The system shall be housed in what is known as the Gas Standards Laboratory at NVFEL, also designated as Room 343A. This room is immediately adjacent to the Gas Standards Storage Room as shown in Figure 1.**

1.4 **Safety, Health and Environmental Provisions**

1.4.1 **Providing for a safe working environment is the highest priority in all EPA equipment purchases and installation activity. The contractor shall abide and comply with any relevant building and safety codes specified by NEC, OSHA, and NFPA wherever they might apply, to create a safe system and work environment.**

1.4.2 **Significant risk factors such as noise, ventilation of toxic gases, heated surfaces, electrical shock, and safety interlocks to prevent accidental errors shall be evaluated by the contractor, and control measures to ensure the safety of operations and maintenance personnel shall be implemented by the contractor wherever feasible.**

1.4.3   **As required by OSHA, all equipment shall be designed to provide for straightforward lockout protection in accordance with OSHA regulations. Written lockout instructions, in hard copy and electronic formats, shall be provided by the contractor as part of the "as installed" documentation package.**

1.4.4   **Noise or vibration from equipment installed as part of this contract shall not penetrate the building or cause adverse affects on other equipment in the facility. Sound dampening/suppression devices and/or materials shall be installed as needed to limit noise levels to 60db at 10 feet from any devices delivered and installed under this contract.**

1.4.5   **The contractor shall consider energy efficiency in all component selection, system design and operational strategies. Energy efficient equipment, such as those with The "Energy Star" designation shall be utilized when possible.**

1.4.6   **The contractor shall strive for the minimization of the generation and release of harmful materials to the environment in all component selection, system design, and operational strategies and installation requirements of this contract. Toxic and Combustible monitoring equipment is not required.**

1.4.7   **Reserved**

1.4.8   **The contractor shall provide the NVFEL Project Officer with a complete list of chemicals to be utilized during installation and commissioning operations at NVFEL, and their associated Material Safety Data Sheets (MSDS), at least four weeks prior to system installation.**

1.5   **Quality Provisions**

1.5.1   **As part of this contract, the EPA is seeking to purchase measurement systems that will produce data of highest precision and accuracy with a high level of certainty, in a manner that can be comprehensively demonstrated and documented. All equipment and all functions performed by measurement systems must be in accordance with the vehicle emissions testing and fuel economy-testing requirements of the Code of Federal Regulations and all other codes, standards, practices, etc. included by reference therein or elsewhere in this document.**

1.5.2   **The contractor shall carefully consider all requirements referenced in this Statement of Work, and all other documents incorporated by reference, and design a complete and efficient quality strategy for ensuring that all systems delivered as part of this**

contract meet those requirements, and will continue to meet them on an on-going basis. This strategy is expected to include automated checks before and after analysis sessions, diagnostic checks, real-time condition monitoring and exception reporting, routine maintenance activities where applicable.

1.5.3   **All documentation and system instructional, alarm and warning messages shall be delivered in a clear, concise manner, in plain English, with a minimum of technical jargon.**

1.5.4   **Systems delivered under this contract are expected to support compliance with ISO 17025, in a complete and efficient manner.**

1.5.5   **Preference will be given for an automated system which monitors and tracks long term performance of key instrument operating parameters such as response, flow, temperature drift, etc., to provide early warning of failure or significant change in operating performance.**

1.5.6   **The contractor shall deliver systems which provide for automated archiving of active as well as previous, or inactive calibration and verification data for all provided instrumentation.**

1.5.7   **The contractor shall provide for the straight forward verification and calibration of all signal conditioning hardware delivered as part of this contract. The contractor does not need to provide electrical standards as part of this requirement but shall provide software tools, any special cables, attachment points or other hardware required to facilitate this operation, as well as sufficient documentation of required procedures.**

1.5.8   **Within the context of this Statement of Work the word "calibration" shall mean:**

Calibration - set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or reference material, and the corresponding values realized by standards. (International Vocabulary of Basic and General Terms in Metrology (VIM; 1993) definition) Furthermore "calibration" shall mean a defined set of actions which produce a permanent record of the relation of instrument response to standards.

Calibration shall not refer to the routine adjustment of instrument offset and gain through the use of "zero and span" materials.

1.5.9   **The delivered systems shall not update any calibration data or other constants that affect results without first explicitly verifying via a dialog box or similar tool that the action should occur. If the update is affirmed, the update shall be implemented immediately without having to reload any portion of the system or take other further action of any kind.**

The update verification dialog box shall provide for operator comments, if any. These updates shall be documented in an electronic log file which stores the old information and new information as part of a clear time-stamped audit trail. The updated log file shall be readily accessible, and copyable. At a minimum, each record in the log file shall include a time-stamp, a clear description of the action taken, the resulting data change, and comments.

This update function shall be available both "real-time," such as immediately following a calibration procedure or at a later time. Changes may be stored as "pending" for later implementation. All pending changes shall be easily retrievable for later authorization via a screen-viewable and printable listing. Only one calibration for any device and range shall be allowed to be "pending" at one time.

1.6   **Operational Efficiency**

1.6.1   **The EPA seeks to maximize value in all its testing operations, and expects the measurement systems delivered as part of this contract to demonstrate a high level of efficiency. The contractor shall consider operational efficiency in all aspects of the design and functioning of these measurement systems. As a simple example, during an automated or semi-automated function, it is expected that the system would provide for the operator to carry on a second task during significant wait times, thus internalizing one operation to another and minimizing the total time required for the entire operation. Other examples would be to provide for unattended operation of lengthy operations.**

1.6.2   **The equipment shall be designed and configured to function satisfactorily for extended periods on a heavy-use basis, except for scheduled maintenance. Significant scheduled maintenance shall be minimized.**

1.6.3   **The measurement system shall be designed and configured to facilitate safe, one-person test operation.**

1.6.4   **All components of the systems specified in this contract must be free of any date-based obsolescence (e.g. "Y2K") problem that would impair operational**

efficiency or veracity through the year 2050.

1.7   Electrical Requirements

1.7.1   Reserved

1.7.2   The EPA will provide the following 3 types of power panels, as required, within 50 feet of the point of use. Motor and other noisy loads will not be allowed on the clean power grid.

> **208 VAC/120 VAC, 1 phase, 60 Hz, utility grade power**
> **480 VAC/277 VAC, 3 phase, 60 Hz, utility grade power**
> **208 VAC/120 VAC, 1 phase, 60 Hz, clean power**

The single phase 120 VAC is ±5%, i.e., 114 to 126 VAC.

1.7.3   All equipment shall be installed in accordance with the most recent edition of NFPA 70, National Electrical Code and required local codes.

1.7.4   Equipment design and installation shall permit operation in compliance with Occupational Safety & Health Administration (OSHA) Standards Part Number 1910. Electrical equipment shall comply with Part 1910 Subpart S.

1.7.5   Equipment design and installation shall be in compliance with the most recent edition of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces.

1.7.6   Equipment design and installation shall provide energy-isolating devices required for equipment operators to follow the OSHA rule on the Control of Hazardous Energy (Lockout/Tagout) of Title 29 of the Code of Federal Regulations (29 CFR) Part 1910.147.

1.7.7   All electrical cables shall be isolated from gas lines.

1.7.8   The contractor is responsible for providing and installing all power circuit disconnects, transformers, circuit protection devices, and associated hardware required to interface with EPA provided power panels of paragraph 1.7.2.

1.7.9   All power receptacles shall be heavy duty, industrial grade. Spare power receptacles for future upgrades and maintenance shall be provided.

1.7.10   **Clean/uninterruptible power outlets shall be clearly marked and in a color selected by the Project Officer.**

1.7.11   **Clean/uninterruptible power outlets shall be isolated from utility grade power systems and installed in accordance with the principles of IEEE Std 1100.**

1.7.12   **All cables external to equipment cabinets with voltages over 50V (AC or DC) shall be run in metal conduit or other EPA approved raceway.**

1.7.13   **Control and signal cables shall be isolated from power cables. All signal cabling shall not be adversely affected due to capacitive or inductive interference.**

1.7.14   **All Control and signal cables/wires shall be permanently labeled with to/from and signal/function name information that corresponds with the provided electrical schematic.**

1.7.15   **All crimp or compression type connections shall use only the component manufacturer's approved crimp tools and shall follow the component manufacturer's termination instructions.**

1.7.16   **Discrete digital input/output (I/O) channels shall be 0 to 5 volt TTL level and shall be optically isolated from their source.**

1.7.17   **Digital I/O communications channels shall conform to recognized industry standards such as IEEE 802, RS232, RS485, IEEE 488, IEEE 1394, or USB.**

1.7.18   **Analog I/O shall support both 0 to 5 VDC and 0 to 10 VDC and thermocouple inputs.**

1.7.19   **The contractor shall provide complete electrical schematics and wire lists in its final documentation package.**

1.8   **Project Management**

1.8.1   **The contractor shall comprehensively manage the project to ensure on-time completion and efficient interaction with EPA during all phases of the project. The contractor shall develop a preliminary project plan for review with EPA at a project kick off meeting. The Project Management plan shall indicate the contractor's project manager, key personnel and contact information, the project time line, and sample formats for meeting minutes, progress reports and open issue tracking. Based on the outcome of the Project Kickoff meeting, the contractor shall deliver a**

complete project management plan as indicated on the Schedule of Deliverables, Appendix H.

1.8.2 **The project management plan should also include the submissions, milestones and events to be completed no later than the dates indicated on the Schedule of Deliverables. Alternate dates for intermediate milestones may be proposed at the Project Kickoff meeting, but all alternatives must be approved by the EPA Project Officer. Technical Interchange Meetings (TIMs) are to be held at EPA-NVFEL. The contractor or EPA, as needed, may schedule TIMs.   The project calendar shall factor in adequate time to review materials in advance of TIMS. Any alteration of dates for intermediate milestones shall NOT effect the final completion date that is established for this project.**

1.8.3 **Full measurement system acceptability shall be demonstrated during the off-site acceptance process. Equipment shipment to EPA shall not occur until this requirement is met. The contractor shall have responsibility for preparing a report thoroughly documenting all quality assurance activities and acceptance results.**

1.8.4 **The contractor shall provide on-site supervision of all installation, commissioning and acceptance activities. All contractor personnel shall receive 1-hour briefing by EPA personnel on specific safety and security issues. All contractor personnel and subcontractor personnel must comply with EPA/NVFEL safety and security measures while working at NVFEL.**

2.0   Gas Laboratory Analysis System - Specific Requirements

2.1 **System Layout and Configuration**

2.1.1 **The contractor shall determine the most efficient layout for the measurement system given the functional requirements of the system, proposed layout of the Gas Standards Laboratory and other guidance and requirements provided by the Statement of Work.**

2.1.2 **The analyzers shall nominally be installed in a 19" rack mount cabinet or equivalent, with all plumbing, valves switches, gauges, control, supplemental instrumentation, wiring and other hardware required to make the system fully functional according to the requirements of this Statement of Work. Utility gases and power connections for the system are to enter the top of the cabinet, as they will be supplied from the top down.**

2.1.3 **All commonly accessed gauges, displays, connection points, maintenance points, valves, switches and other controls shall be placed in ergonomically efficient locations. A block diagram illustrating certain layout preferences is found in Figure 2. A pullout writing surface shall be included at an ergonomically efficient height, generally 40" to 43" AFF as shown in Figure 2.**

2.1.4 **At NVFEL, gas standards are typically purchased in K-size cylinders and stored on carts in groups of six. The configuration of the measurement system in the Gas Standards Laboratory shall consider and allow for movement of these carts in and out of close proximity to the analysis bench.**

2.1.5 **The system shall be designed for the permanent connection of zero air, nitrogen, FID fuel, the oxidant required by the chemiluminescent analyzer, system exhaust vent and any other utility gases required by the design and configuration of the delivered system.**

2.1.6 **The main connection point for gas standards, and other gas cylinders to be analyzed, shall be via a 1/4 inch quick-connect, Swagelok FS-QC4-B1-400.**

2.1.7 **All features of TDAP shall be readily adaptable for future expansion. At a minimum, the system layout and design shall provide for the straight-forward incorporation of four additional analyzers from any vendor. This extension will be performed by EPA staff with minimal additional support from the vendor. The TDAP system must include hardware for communication with any analyzer using analog/digital inputs/outputs. Digital communication hardware must include capability for using the LONworks protocol (eg. Rosemont) or the AK protocol (eg. Pierburg, Signal, Horiba).**

2.1.8 **All sample lines and utility gas lines are to be of 1/4 or 1/8" 316 passivated and electropolished stainless steel ($\leq$10 RA.) tubing construction, cleaned on the interior and have removable filters between the utility gas lines and the analyzer supply inlets. Two of the four expansion slots for analyzers are to have 1/4" sample lines.**

2.1.9 **The contractor shall provide separate sample inlets for each analyzer, and separate sample inlets for low concentration samples and high concentration samples on those analyzers with a wide range. The lowest concentrations of analyte will have the sample paths configured such that any residual response is no more than 0.1% of the lowest scale on each analyzer . The analyzers shall be packaged to suit the layouts illustrated in the attached Figures 1, 2, and 3, and information gathered from the site survey.**

2.1.10   There shall be no sample pumps in the system. The intent is to prevent exhaust samples from being drawn into and contaminating the system. There shall be an evacuation pump for evacuating and purging the sample lines. This pump shall be oil-free, fairly quiet, and have very low maintenance. All solenoid valves will have stainless steel bases and plungers constructed of a durable material which does not out-gas or otherwise change the composition of the gas flowing past them.

2.1.11   Stainless steel lines shall use 1/8" or 1/4" fittings, as appropriate. Gas pressures should be locally controlled to a nominal range of 5-15 psig to reduce gas usage at the bench and shall be controlled by dedicated high purity regulators. Internal analysis system regulators shall provide for the final pressure regulation for consistent flow control in the zero, span, and sampling modes to minimize any effects from pressure differences. Inlets for zero gases, ozone generator source gas and FID fuel shall have sintered metal filters.

2.1.12   Any fittings used shall be compatible with the pipework installation, be good quality and installed according to commonly accepted engineering practices. All pipework systems shall be pressure tested and proven to have no leaks. As installed there shall be no contamination that would influence measurements on any available ranges of the analyzers. Low range analyzers require purge of the analytical equipment and back flush of the sample lines. This should be performed with a suitably clean supply of zero grade Nitrogen.

2.1.13   Filters shall be provided to remove particles bigger than 0.3 micron in the utility gas lines before entering any analyzer. These filters shall have an efficiency of greater than 99% and be made from a non-reactive material. There shall be no filters in any sample line.

2.2   **High Performance Gaseous Analytical Instruments**

2.2.1   NVFEL seeks the best ultimate performance in the specifications in this section. The listed specifications are believed to be easily attainable in high performance instruments available at this time, but other specifications will be considered based on the merits of the individual instruments and their associated specifications.

2.2.2   All analytical systems shall use single range digital format analyzers that have high A/D resolution including five digit counts for zero and six digits at full scale span. The calibration and analyses processes shall use sampling and averaging algorithms to precisely determine gas concentrations. Single range analyzers shall support the use of predefined virtual ranges in order to achieve the most accurate calibration

over the limited concentration range of interest at the time of analysis. The use of the word "range" in this Statement of Work will refer to those predefined concentration ranges. The term "full scale" shall be used to define the upper limit of any range.

2.2.3   A magneto-pneumatic style oxygen analyzer that can measure 0-25% oxygen concentrations, shall be integrated into the analysis system.

2.2.4   All analyzers shall be designed to be used as automotive emissions analyzers.

2.2.5   Analyzers are expected transmit data to the bench computer digitally to maximize resolution and stability. The availability of auxiliary analog outputs of concentration shall be available for optional use with other external displays or data loggers.

Analyzer Performance Requirements

2.2.6   Response - The analyzers shall respond to 95% of final reading within 3.0 seconds of the gas appearing at the analyzer inlet port. Down scale response must be such that the analyzer reads less than 2% of span reading (span = approximately 85% range) within 3.0 seconds of zero gas appearing at the analyzer inlet port. The time to achieve a true zero from 2% of span should not be more than 30 seconds. This is required to prevent negative readings caused by high zero readings during zero/span adjustment.

2.2.7   Optimization - The optimization for all analyzers shall be an easily performed task (as automated as possible) and shall be fully described in the documentation or on-line procedures. This includes but is not limited to electrical and optical adjustment and alignments as well as optimization of instrument flows and pressures.

2.2.8   Resolution and Repeatability - All analyzers shall be able to resolve a concentration that is ≤1% of the lowest quoted range of the analyzer. For example; if a dilute analyzer is quoted with a lowest range of 1ppm it shall have a resolution better than 0.01 ppm and repeatability of ≤0.25% of the full scale value when tested by analyzing ten alternating zeros and spans each consisting of 1 minute zero and 1 minute of span gas at approximately 85% of full scale dynamic (FSD). All ranges must conform to the repeatability requirement.

2.2.9   Reserved

2.2.10 **Detection Limit - The detection limit is defined in this document as: the minimum concentration of an analyte gas that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero and is determined from replicate analyses of a gas sample in a given matrix containing analyte.**

2.2.11 **Calibration - Analyzers shall be calibrated on each range identified as an active computer range using a suitable number of gas concentrations (cylinders and/or gas divider blends) to satisfy CFR requirements, and requirements set forth in this document, and to determine accuracy, resolution, and repeatability. For single range analyzers, sufficient calibration points must be available to emulate the performance and response of a multi-range analyzer. Accuracy and repeatability limits should not be exceeded during the periods between calibrations.**

2.2.12 **Interference - Interferences are relative to pure dry gases, not engine/vehicle exhaust. The Total Hydrocarbon FID shall have an automatic oxygen check option. When directed to do so by way of a check button, for the 0-5 ppmC range, the sample stream (C3 or other HC in air) will temporarily be switched to the oxygen analyzer and the oxygen level determined. If the result is outside the limits of 20 - 21% the operator will be flagged that such a condition exists. Influence of oxygen must be $\leq$ 1% at a nominal concentration of 4 ppm C3.**

2.2.13 **The ranges specified are nominal values and some latitude and flexibility is permitted if the contractor substantiates the variation. If auto scaling is included in continuous measurement functions, it shall provide for "seamless" measurement without compromise as to accuracy, precision or data continuity.**

Analyzers that have the ability to accurately measure lower concentrations than those specified below, and within reasonable noise and repeatability specifications will be given preference.

Component Specifications

2.2.14 **Low NO/NOx**   **Oxides of Nitrogen Chemiluminescence; to obtain the required precision on the lowest range and for compatibility with the production analyzers.**

Ranges: **$\leq$ 0-3 / 0-100 ppm molar volume (scalable single range) Readout is to be in both corrected counts and ppm molar volume.**

Detection Limit:	**≤ 5 ppb**
Repeatability:	**≤ 0.3% of measured value**
Drift:	**≤ 0.5% of measured value / hour**
Response Time:	**≤ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**≤ 1.0% of measured value**
Linearity:	**≤ 1.0% of measured value**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86 and results shall not be affected by the presence or absence of other oxygenated compounds such as higher levels of CO and CO2. Interferences are to be identified, quantified, and compensated.**

2.2.15 **High NO/NOx** **Oxides of Nitrogen Chemiluminescence; to obtain the required precision on the lowest range and for compatibility with the production analyzers.**

Ranges:	**0-100 / 0-5,000 ppm molar volume (scalable single range) Readout is to be in both corrected counts and ppm molar volume.**
Detection Limit:	**≤ 35 ppb**
Repeatability:	**≤ 0.3% of measured value**
Drift:	**≤ 0.5% of measured value / hour**
Response Time:	**≤ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**≤ 1.0% of measured value**
Linearity:	**≤ 1.0% of measured value**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86. Interferences are to be identified, quantified, and compensated.**

2.2.16 **Low THC-FID** **Total Hydrocarbon Flame Ionization Detector**

Ranges:	**≤ 0-3 / 0-50 ppmC3 (scalable single range); readout in C3**
Detection Limit:	**≤ 8 ppb C3**
Repeatability:	**≤ 0.5% of measured value**
Drift:	**≤ 0.5% of measured value / hour**
Response Time:	**≤ 3.0 seconds to 90 % full scale at rated instrument sample flow**

Noise:	$\leq$ **1% of measured value**	
Linearity:	$\leq$ **1% of measured value**	
Outputs:	**Digital display and transfer for computer storage** **($\pm$x.xxxxxxE$\pm$nn)**	
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**	
Optimization:	**As per CFR 40, Part 86 and CARB specifications**	
O$_2$ Interference:	$\leq$ **1% of measured value**	

2.2.17 **High THC-FID** **Total Hydrocarbon Flame Ionization Detector**

Ranges:	**0-100 / 0-10,000 ppmC3 (scalable single range); readout in C3**
Detection Limit:	$\leq$ **30 ppb C3**
Repeatability:	$\leq$ **0.5% of measured value**
Drift:	$\leq$ **0.5% of measured value / hour**
Response Time:	$\leq$ **3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	$\leq$ **1% of measured value**
Linearity:	$\leq$ **1% of measured value**
Outputs:	**Digital display and transfer for computer storage** **($\pm$x.xxxxxxE$\pm$nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Optimization:	**As per CFR 40, Part 86 and CARB specifications**
O$_2$ Interference:	$\leq$ **1% of measured value**

2.2.18 **Extreme Low CO** **NDIR, optical filter, capacitive type. Other technologies that are equivalent will be considered.**

Ranges:	**0-10 / 0-1000 ppm molar volume (scalable single range)** **Readout is to be in both corrected counts and ppm molar volume.**
Detection Limit:	$\leq$ **0.5% full lowest range**
Repeatability:	$\leq$ **0.2% of measured value**
Drift:	**Zero:** $\leq$ **1.0% of lowest measuring range / day** **Span:** $\leq$ **1.0% of measured value**
Response Time:	$\leq$ **3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	$\leq$ **1.0% of measured value**
Linearity:	$\leq$ **1.0% full scale**
Outputs:	**Digital display and transfer for computer storage** **($\pm$x.xxxxxxE$\pm$nn),**

Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86**
	The analyzers cross response to CO_2 to be less than $\pm$ l% FSD for ranges above 100 ppm or response compensated for these interferences. For ranges below 100 ppm cross response to be less than $\pm$ 0.1 ppm or response compensated for these interferences. In addition, results shall not be affected by the presence of other species such as N_2O, NO, NO_2. All interferences are to be identified, quantified, and compensated.

2.2.19   <u>Mid CO</u>   **NDIR, optical filter, capacitive type. Other technologies that are equivalent will be considered.**

Ranges:	**0-200 / 0-5000 ppm molar volume (scalable single range) Readout is to be in both corrected counts and ppm molar volume.**
Detection Limit:	**$\leq$ 0.5% full lowest range**
Repeatability:	**$\leq$ 0.2% of measured value**
Drift:	**Zero: $\leq$ 1.0% of lowest measuring range / day**
	Span: $\leq$ 1.0% of measured value
Response Time:	**$\leq$ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**$\leq$ 1.0% of measured value**
Linearity:	**$\leq$ 1.0% full scale**
Outputs:	**Digital display and transfer for computer storage ($\pm$x.xxxxxxE$\pm$nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86**
	Interferences are to be identified, quantified, and compensated.

2.2.20   **High CO**   **NDIR, optical filter, capacitive type. Other technologies that are equivalent will be considered.**

Ranges:	**0-0.5% / 0-10% molar volume (scalable single range) Readout is to be in both corrected counts and % molar volume.**
Detection Limit:	**$\leq$ 100 ppb**
Repeatability:	**$\leq$ 0.5% of measured value**
Drift:	**Zero: $\leq$ 1.0% of lowest measuring range / day**

	Span:	**$\leq$ 1.0% of measured value**
Response Time:		**$\leq$ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:		**$\leq$ 1.0% of measured value**
Linearity:		**$\leq$ 1.0% full scale**
Outputs:		**Digital display and transfer for computer storage ($\pm$x.xxxxxxE$\pm$nn)**
Calibration:		**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:		**As per CFR 40, Part 86 Interferences are to be identified, quantified, and compensated.**

2.2.21a   Low CO2   **NDIR, optical filter, capacitive type. Other technologies that are equivalent will be considered.**

Ranges:	**0-250 / 0-5000 ppm molar volume (scalable single range) Readout is to be in both corrected counts and ppm molar volume.**
Detection Limit:	**$\leq$ 15 ppm**
Repeatability:	**$\leq$ 0.5% of measured value**
Drift:	**Zero: $\leq$ 1.0% of lowest measuring range / day Span: $\leq$ 1.0% of measured value**
Response Time:	**$\leq$ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**$\leq$ 1.0% of measured value**
Linearity:	**$\leq$ 1.0% of full scale**
Outputs:	**Digital display and transfer for computer storage ($\pm$x.xxxxxxE$\pm$nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86 Interferences are to be identified, quantified, and compensated.**

2.2.21   High CO2   **NDIR, optical filter, capacitive type. Other technologies that are equivalent will be considered.**

Ranges:	**0 - 1.0 / 0-20 percent molar volume (scalable single range) Readout is to be in both corrected counts and % molar volume.**
Detection Limit:	**$\leq$ 15 ppm**

Repeatability:	$\le$ **0.5% of measured value**
Drift:	**Zero:** $\le$ **1.0% of lowest measuring range / day**
	Span: $\le$ **1.0% of measured value**
Response Time:	$\le$ **3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	$\le$ **1.0% of measured value**
Linearity:	$\le$ **1.0% of full scale**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86**
	Interferences are to be identified, quantified, and compensated.

2.2.22 Low CH4-GC/FID Methane analysis using columns and GC.

Ranges:	**0-5 / 0-15 / 0-75 ppm C1 molar volume (scalable single range)**
	Readout is to be in both corrected counts and ppm molar volume.
Detection Limit:	$\le$ **20 ppb C1**
Accuracy:	$\le$ **2% of span**
Precision:	$\le$ **2% of measured value**
Drift:	**Span:** $\le$ **3.0% of current range**
Response Time:	**70 seconds analysis time at rated instrument sample flow**
	Sample column separation and analysis time of less than 1 minute
Noise:	$\le$ **1.0% of measured value**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**Interferences are to be identified, quantified, and compensated.**
Other:	**FID response shall be optimized**

2.2.23 High CH4-GC/FID   Methane analysis using columns and GC.

Ranges:	**0-50 / 0-500 ppm C1 molar volume (scalable single range)**
	Readout is to be in both corrected counts and ppm molar

volume.

Detection Limit:	**≤ 20 ppb C1**
Repeatability:	**≤ 0.3% of measured value**
Drift:	**≤ 0.5% of measured value / hour**
Response Time:	**≤ 3.0 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**≤ 1.0% of measured value**
Linearity:	**≤ 1.0% of measured value**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**Interferences are to be identified, quantified, and compensated.**
Other:	**FID response shall be optimized**

2.2.24 O2 in Air   **Magneto-pneumatic measurement principles.**
Response shall be linear over its dynamic range.

Ranges:	**0-1.0 / 0-25 percent molar volume (scalable single range)** **Readout is to be in both corrected counts and % molar volume.**
Detection Limit:	**≤ 15 ppm**
Repeatability:	**≤ 0.5% of measured value**
Drift:	**Zero: ≤ 1.0% of lowest measuring range / day** **Span: ≤ 1.0% of measured value**
Response time:	**≤ 4 seconds to 90 % full scale at rated instrument sample flow**
Noise:	**≤ 1.0% of measured value**
Linearity:	**≤ 1.0% full scale and ≤ 2.0% measured value**
Outputs:	**Digital display and transfer for computer storage (±x.xxxxxxE±nn)**
Calibration:	**As per CFR 40, Part 86 using automated dividers and cylinders**
Interference:	**As per CFR 40, Part 86** **Interferences are to be identified, quantified, and compensated.**

2.2.25 Reserved

2.2.26 Reserved

2.2.27 Permanent labels shall be attached to the analyzer cabinet, in English, to identify

each analyzer in the cabinet.

2.2.28 **The Gas Laboratory Analysis System shall incorporate an LNI gas divider capable of generating accurate calibration gases automatically and meeting the minimum requirements of the CFR Part 86 and the NVFEL in-house test procedure criteria for all analyzers. The gas divider shall be calibrated in a manner that is traceable to NIST, or equivalent. A certificate of calibration shall be provided with this instrument. The contractor shall provide a gas divider system that has the capability to generate 128 or more user definable points with the minimal cut point at 0.2% FS and with an accuracy of ±1% of point down to 10% of full scale. Complete calibration sequences shall be possible via manual control or unattended computer control.**

2.2.29 **Specifications for this Gas Divider are as follows:**

Type:	**Sonic Nozzle Technology**
Output Flow Rate:	**Up to 5 L/minute**
Output Pressure:	**4 ± 0.7 psig**
Mixing Ratio:	**1.0 to 90%, 0, 100% of component gas concentration for 2 to 5 L/min.**
	0.2 to 90%, 0, 100% with maintained 5 L/min.
Accuracy:	**≤ ± 0.5% of point relative**
Precision:	**≤ ± 0.5% of point relative**
Repeatability:	**≤ ± 0.2% of point relative**
Component Gas	
Pressure:	**43 ± 7 psig**
Base Gas:	**Both air or nitrogen**
Connections:	**1/4" Swagelok, internal and external**

Materials in contact with the gas shall be of inert materials such as stainless steel and Teflon.

2.3 **Reserved**

2.4 **Reserved**

2.5 **Test-Control, Data Acquisition and Processing System (TDAP)**

2.5.1 **This system of computers, logic controllers, displays and associated devices, as configured by the contractor shall integrate and control operation of the analytical**

systems, collect all data directly related to processing calibrations and naming standards, and use a data table of gas cylinder information.

TDAP shall provide a clear, simple and logical user interface. It shall perform associated quality control of the gas naming process and provide rigorous documentation associated with quality control and traceability. TDAP shall provide a degree of automation of most tasks associated with these activities. It shall provide for processing, reporting and file transfer of collected data and supplemental information. Preference will be given to systems that provide a range of flexible data analysis tools to support ad hoc trouble shooting and the detection of adverse trends.

EPA recognizes that suppliers may distribute these functions among various system components. To allow for this variety of solutions the term TDAP is used in this SOW to represent the sum-total of microprocessor functions within an offered system, and not any particular subset, or partitioning of those functions. Therefore, TDAP may consist of a range of hardware and software components depending on the configuration and functioning of the contractor's measurement systems, provided the automation, information and functional requirements contained in this Statement of Work are met.

2.5.2 TDAP computer system(s) shall utilize color and real-time graphics and shall provide for a multiple window operating system.

2.5.3 All TDAP operating system software, control software, and data acquisition interfaces shall be stored and accessed using the most up to date commercially available standard microcomputer hardware and most up to date Commercial Off the Shelf (COTS) components where possible.

2.5.4 The computer interface(s) shall be designed such that personnel without special computer experience will be able to operate the control system and the peripheral units, including the input of parameter changes, with minimal basic system training.

2.5.9 For all operations, TDAP shall display run time information on the main display screen in logical, hierarchical manner. A real time, scalable display vs. time (both as a line and as a numerical value) of any variable in the system shall be available on screen during an analysis sequence.

2.5.10 Any window on a TDAP display screen shall be printable to the system laser printer and shall be automatically scaled to fit the page.

2.5.11 The current date and time, in any format that contains month, day, year, hour,

minute, and second, shall be contained on all printed images of screens, files, or reports from the system. The system name from which the output was generated shall also be contained on the printout.

2.5.12 **TDAP shall provide for all data acquisition required for all functions related to the performance of this Statement of Work:**

(a)   All pressures required for calculations, such as barometric pressure, and for operational monitoring and quality control

(b)   All temperatures required for calculations and for operational monitoring and quality control

(c)   All flow rates required for calculations and for operational monitoring and quality control

(d)   All concentrations required for calculations and for operational monitoring and quality control

(e)   Gas Standards Laboratory ambient humidity

(f)   Any other measurements the contractor deems appropriate for the functions specified and requirements of its product.

2.5.13 **Reserved**

2.5.14 **TDAP shall include a color laser printer for standard printing functions as follows:**

HP LaserJet 8550DN (Duplex and network) or current equivalent model

2.5.15 **Reserved**

2.5.16 **The contractor shall integrate the TDAP with a separate EPA supplied network interface computer (IFC), described in Appendix C. The TDAP-IFC integration shall provide a direct and controlled communication link between the test system and the EPA/NVFEL Laboratory Network System (LNS) via a network switch. A block diagram showing the desired Gas Standards Laboratory / LNS architecture may be found in Figure 3.**

The purpose of the IFC is to provide a uniform, controlled and restricted interface between laboratory instrumentation and the Laboratory Network System. The use

of IFCs at NVFEL allows for isolation of instrumentation from other extraneous laboratory and network activity. The communication with the IFC shall function only to provide for the passing of files between the test site system (TDAP) and the IFC. No programming of the IFC is requested. Data exchange with the IFC is addressed in section 2.5.31.

2.5.17   **Reserved**

2.5.18   **Preference will be given to contractors that can provide connection and interface for a variety of gas dividers. Because the EPA already has multiple Horiba GDC-703 dividers, support for this divider is desired. Support for the LNI divider is required. This integration shall be for controlling and monitoring those dividers sufficiently for the purpose of checking the precision, accuracy, stability and hysteresis of those gas dividers as a routine quality check.**

2.5.19   **Reserved**

2.5.20   **The principal requirement for TDAP is to provide flexible tools for the partial automation of gas analysis, maintenance and support functions, and data acquisition and processing for these functions. These tools shall support operational efficiency and optimize the analysis outcome by minimizing uncertainty. The tools shall also support quality control monitoring, documentation, and reporting, to assure and document analysis traceability and uncertainty.**

The following portions of Section 2.5 further elaborate on these requirements and present the basic framework for interaction of the Gas Laboratory Analysis System with EPA computer systems and work methods. EPA recognizes that alternate approaches that deviate somewhat from the details of some of the following requirements may be equivalent or superior. To that end, EPA will exercise some flexibility in considering alternate approaches, to the extent that those alternatives enhance project goals and the operational features outlined below, and are consistent with EPA computer system requirements and work practices.

2.5.21   **At a minimum, TDAP shall provide implemented, automated processes within the following functional areas. For each process TDAP shall provide for all relevant operator interface, data acquisition, data analysis, storage and reporting and operational quality control.**

    (a)   **Administrative Functions**
    (b)   **Gas Analysis Functions**
    (c)   **Pre-Session Configuration of Analysis Session**
    (d)   **Analysis Phase**

(e)   **Maintenance Functions**
(f)   **Data Analysis and Reporting Functions**

Other processes than those listed below will be considered based on their merit and applicability to the proposed system. NVFEL will look for those that provide the most complete functionality to that which is desired.

<u>**Administrative Functions**</u>

2.5.22   **TDAP shall include hardware and implemented procedures for the following administrative functions, as well as any other functions deemed appropriate by the contractor based on its expertise and the design of its products:**

      (a)   **Complete system backup & restore from CD or DVD media (system bootable from CD or DVD).**
      (b)   **System configuration, parameters backup & restore.**
      (c)   **Data backup & restore (to be done ad hoc or daily).**
      (d)   **Procedures to file trim based on creation date or modification date**
      (e)   **Complete power-down and power-up procedure sequence.**
      (f)   **Virus scanning and protection.**

2.5.23   **All access to TDAP shall be password protected as follows:**

    (a)   **Level 0**   **(Base Maintenance) - Routine system maintenance functions only, to include automated backup and file trimming procedures.**
    (b)   **Level 1**   **(Operator) - Routine system maintenance functions, to include automated backup and file trimming procedures. The ability to run defined analysis sessions, view active channel displays, read (but not change) analysis sessions scripts, definitions, variable names and other related files, view and print reports, and use interactive functions for analyzing data.**
    (c)   **Level 2**   **(Maintenance/Repair) - All level 1 plus the ability to perform diagnostic tests, and perform routine maintenance and trouble shooting functions.**
    (d)   **Level 3**   **(Administrative/Engineering) - Full system access. All level 2 plus the ability to edit analysis sessions scripts, channel configurations, bit maps, tables, user-defined variables, alarm actions, report definitions, and system configuration, and other administrative functions.**

2.5.24 TDAP shall include a selectable option, configurable at Level 3, to automatically log-out after a predefined duration of system inactivity.

<u>**Gas Analysis Functions**</u>

2.5.25 For purposes of this Statement of Work, the term "analysis session" will be used to describe a set of analyses that are being performed for establishing the official concentration of new standards, and other materials considered to be unknowns. The process of officially ending and accepting the results of the analysis and making the results official and useable, will be referred to as "closing the analysis session". The term "naming" shall mean the assignment of the official concentration of a gas standard through the analysis process. In a similar fashion, the term "name" shall refer to the official concentration assigned to a gas cylinder.

2.5.26 Analysis functions shall be available as manual or semi-automated in at least two modes of operation:

    (a) Analysis Session for determining the official concentration of new standards or other unknowns.
    (b) Discrete single function capability for ad-hoc operations both with or without data logging, data storage and reporting capabilities.

2.5.27 Reserved

2.5.28 TDAP shall provide for the straight forward configuration and execution of an analysis session. An analysis session shall typically involve the analysis of traceable standards, NIST SRMs or other quality check materials, zero gas and unknowns. Typically there will also be multiple analyses of some or all of these materials to assess repeatability and optimize the precision of the analysis. The number of analyses of each type of gas analyzed (e.g. "standard," "unknown," etc.) shall be operator selectable.

2.5.29 Reserved

2.5.30 An analysis session shall span an amount of time that is highly variable but once the session is closed, no further operations shall be added to the session. In addition, no changes to the calibration curve(s) generated or any other aspects of the results shall be allowed after that point.

2.5.31 The analysis session will typically consist of the following phases:

(a) Pre-session configuration, which shall include the receipt of the latest LNS Gas Cylinder Inventory Database from the IFC, and the determination of specific session related information.

(b) The analysis phase which shall include the analysis of individual gases and automatic acquisition of data, within a flexible and interactive environment created to optimize the efficiency and quality of the analysis.

(c) Post-session analysis, validation and reporting. This portion of the session shall include the interactive data analysis tools available during the analysis phase, interactive review of any quality flags including the creation or editing of notes and explanations, explicit analyst validation of the session which will serve to close the session, and the creation and printing of reports. The closing of the analysis session will also serve to make session results available to the IFC for it to update the LNS gas cylinder database.

Pre-Session Configuration of Analysis Session

2.5.32 The analysis session shall be capable of being both pre-configured and/or configured real time. If pre-configured, additional cylinders may be added, or repeat analyses conducted at any time. In addition some of the configuration parameters shall be modifiable, until the session is closed.

2.5.33 User configurable options and quality control parameters shall be stored in easily retrievable and modifiable tables that can be readily selected when configuring an analysis session. These tables shall be automatically and uniquely identified when created. Later modifications of any tables shall result in the creation of a new table leaving the old table unchanged as a permanent record. Tables shall also have an optional user generated text-type name for easy recognition and retrieval. Data collected as part of each analysis session will include the exact final configuration options utilized, some of which may be modified during the analysis session as well as the designation of the specific quality control parameter table utilized.

2.5.34 Configuration tables shall minimally include the following items, as well as any other options deemed appropriate by the contractor based on its expertise and the design of its products. As indicated, certain options shall be modifiable during the analysis session.

(a) The option to evacuate the sample lines, on the low range analyzers, from the instrument to a nominal vacuum of 5 torr prior to each sample or standard introduction, and an evac-purge-evac cycle option. Evacuation shall

automatically cease once the desired vacuum is obtained. Alternative designs will be considered.

(b) The option to invoke applicable dynamic corrections. If invoked, corrections shall be applied to all final determinations for that analysis session. (Modifiable)

(c) The option to utilize the system gas divider to generate part or all of the calibration curve. If the gas divider is to be used, the configuration tool shall prompt for appropriate cut point information.

(d) Sample time, stability, drift and averaging criteria

(e) Ability to use a bar code reader to validate cylinder ID immediately prior to analysis, and ability to manually enter cylinder ID. (Modifiable)

(f) Option to automatically shut off gas flow after successful reading is taken (Modifiable)

(g) Option to automatically abort reading and shut off gas flow after specified time limit (Modifiable)

(h) Option to sound chime at completion of successful reading (Modifiable)

(i) Option to sound an alert whenever an on-screen warning or flag is displayed

(j) Curve fitting options (Modifiable)
Least squares regression
Curve order (up to fourth order)
Weighting (un-weighted or 1/y weighting)
Intercept (forced zero, floating zero)

2.5.35 Alarm limits and control parameter limits shall be modifiable, as well as any other parameters deemed appropriate by the contractor based on its expertise and the design of its products.

2.5.36 Closed analysis sessions shall also be available as templates for new session configuration to minimize entry of items which often stay the same from session to session. This is expected to be the most frequently used tool to expedite the configuration of the analysis session. When this method is utilized for session configuration the closed session will not be changed, and the new session must be stored in its own new files or records.

2.5.37 Basic gas cylinder information will nominally be available from the LNS gas cylinder inventory database. TDAP shall acquire the most current version of this database via interaction with the IFC as part of the pre-analysis configuration. Specific data items to be acquired from this database are designated in Appendix E, "Data Dictionary."

2.5.38 At the formal completion of the analysis session, TDAP will make the the updated

cylinder database records, including official gas names available to the IFC for updating the NVFEL gas cylinder inventory. In addition, TDAP shall provide for the analysis and identification of gases which are not intended for inclusion in the LNS gas cylinder inventory, such as cylinders for round robin analyses. Data related to these gases shall be retained only within TDAP and not exported as part of the post session processing.

2.5.39 **All dialog boxes utilized for collecting Pre-Session and Post-Session information shall be easily modifiable so as to accommodate future information requirements. Such modifications shall result in the incorporation of new data into the session record.**

2.5.40 **Analysis session configuration data shall minimally consist of the following parameters, and other parameters deemed necessary by the contractor based on its expertise and the specific design and configuration of its systems.**

(a) **Automatic prompt for verification of system date/time correctness and opportunity to modify**

(b) **Importation of current gas cylinder database from IFC**

(c) **Retrieval or entry of specific gas cylinder information as follows:**

* **Cylinder IDs**
   During session configuration, cylinder ID shall be available from pull down menus, bar code scanner or key entry. All current data associated with that cylinder shall be available from the gas cylinder inventory database. TDAP shall also allow for manual creation of cylinder IDs for miscellaneous gases designated to be excluded from the LNS gas cylinder inventory database. For these gases the unique cylinder identifier shall be Cylinder ID which shall be the prefix X plus a TDAP assigned unique sequence number.

* **Other gas cylinder information from inventory database with verification prompt and manual input/modification as appropriate**

* **Reason for analysis**
   The configuration of the session will include the nominal reason for the analysis of the cylinder in the session as follows (Modifiable until analysis session is closed.):
   * **Span adjust (top cylinder in range)**
   * **Zero adjust**
   * **Span check**
   * **Zero check**
   * **Curve generation standards**

* **NIST SRM or equivalent (used to establish traceability)**
* **Other quality control check analysis (e.g. duplicate analysis)**
* **Cylinder to be officially named**

Session Data

2.5.41   TDAP shall also record the following additional session data.

* **Session Number (Automatically assigned)**
* **Session Status (Automatically configured as "Pending" until the session is explicitly closed.)**
* **Session Configuration Date/Time (Automatically assigned)**
* **Session Analysis Begin Date/Time (Automatically assigned)**
* **Session Analysis End Date/Time (Automatically assigned)**
* **Session Close Date/Time (Automatically assigned)**
* **Operator identification (Modifiable until analysis begins.)**
* **Analyte**
* **Diluent**
* **Concentration Range**
* **Configuration table options (Modifiable, as designated, until session is closed)**
* **Quality Control limit table designation**
* **Curve fit selection (from configuration table, modifiable until analysis session is closed.)**
* **All designations required to fully describe current Gas Laboratory Analysis System hardware and software configurations and most recent calibrations of any and all support equipment, including traceability status, as required (Automatically retrieved)**
    * **Associated instrument identification**
    * **Auxiliary measurement device identification (such as barometer if barometric pressure correction is employed, flow meters, etc.- automatically retrieved)**
    * **Auxiliary measurement device calibration and traceability status information (automatically retrieved)**

2.5.42   Reserved

Analysis Phase

2.5.43   During the analysis phase TDAP shall acquire all measurement data at 10 Hz (nominal) and store and make it available at 1 Hz. One Hz data shall be the 1-second

average of the acquired data. "Processed data," average readings, concentrations, etc, shall be stored in a separate file. TDAP shall also record and permanently store a separate event log of all operations, alarms, warnings etc.

2.5.44   If cylinder IDs have been pre-configured, TDAP shall prompt the analyst to connect the gas cylinder and verify connection of the proper cylinder, either by input of barcode reading, keystroke or mouse click, as configured. TDAP shall allow for the addition of any cylinder, or repetition of any analysis, at any time until the session is closed.

2.5.45   To ensure the integrity and quality of the analysis process, TDAP shall monitor run time conditions and critical operating parameters, and evaluate analysis session criteria. This monitoring and evaluation shall be accomplished according to control parameters, other portions of this Statement of Work and other criteria deemed necessary by the contractor based on their expertise and the specific design and configuration of its systems. The goal of the control function shall be to ensure robust analyses at minimum uncertainty. This shall be accomplished to the greatest extent possible as a "real-time" function during the analysis session for greatest efficiency and effectiveness.

2.5.46   Control warnings and alarms shall be displayed during the analysis session, so that out of tolerance conditions may be rectified whenever possible. These warnings and alarms shall also be recorded in the event log. When the analysis session is closed the final report package shall include explicit identification of control errors.

2.5.47   A detailed specification of the proposed final run time control and reporting function shall be submitted to EPA for approval as described in the Project Management Section of this Statement of Work.

2.5.48   The analysis session shall be configurable to optionally retrieve and use a previous calibration curve or create a new curve (nominal).

2.5.49   An analysis session shall span an amount of time that is highly variable, but once the session is closed, no further operations shall be added to the session. In addition no changes can be made to the calibration curve(s) generated or any other aspects of the results.

2.5.50   Dates and times shall all be automatically entered for each analysis. The adjustment of recorded time-stamps shall not be allowed during the analysis session.

2.5.51   All measurements made during the analysis session shall be preserved, although the

results may be designated as invalid and not utilized in any way to influence the analysis. TDAP shall facilitate entry of comments to address excluded measurements.

2.5.52 **Results of the analysis of standards shall be used as part of the calibration curve as designated on the display screen by some simple form of analyst input, such as a check box. The calibration curve shall be dynamically generated and updated by additional analyses and/or selection and de-selection of individual analyses of designated standards.**

2.5.53 **Run time displays shall be designed to maximize the efficiency of the analysis process and shall include appropriate graphical and text displays.**

2.5.54 **Throughout the analysis session cylinder IDs shall be available from pull down menus, bar code scanner or key entry. All available data associated with that cylinder shall be obtained from the NVFEL cylinder inventory. TDAP shall be configurable to require that during analysis sessions, the system has the option of using cylinder identification via a barcode scan immediately before the analysis of the cylinder for any cylinder used in creating the calibration curve, any NIST SRM or equivalent standard, or any standard to be assigned an NIST traceable concentration during the analysis session. This option shall also be modifiable or override-able at any time.**

2.5.55 **Analysis results recorded shall include resulting cylinder concentration based on the results of the analysis sessions. For any "Cylinder to be officially named" this becomes the official concentration of the cylinder when the analysis session is closed**

2.5.56 **Reserved**

2.5.57 **In addition to the provisions outlined for analysis sessions the Gas Laboratory Analysis System shall provide for informal analysis of gases in a "manual" or semi manual fashion. Although this function shall not be employed in the process of creating new calibration curves or official concentrations, TDAP shall provide for data acquisition and reporting of results associated with this function as a user selectable option. In manual mode TDAP will allow for the activation of previous calibrations for the display and reporting of concentration information.**

2.5.58 **The Gas Laboratory Analysis System shall provide the following additional Manual or "Button Functions" available as part of an analysis session or as discrete single functions for ad-hoc operations with or without data logging.**

(a) **Zero/span set**
(b) **Span check with automatic timed shut-off option**
(c) **Zero check with timer option**
(d) **Back flush with timer option**
(e) **Line purge with timer option**
(f) **Turn data logging on/off**
(g) **Key in cylinder ID, bar code entry or menu entry**
(h) **Sample port read only with selectable and configurable options for**
   Stability criteria
   Timed gas shut-off
   Zero span offset adjustment
   Gas specific corrections

2.5.59 **TDAP shall allow for the establishment of the default configuration of selectable options. For analysis sessions this shall be accomplished through selection of a prior analysis session to serve as a template or via a selectable configuration table. For manual operations this shall be done via selection of a configuration table.**

Maintenance Functions

2.5.60 **At a minimum, TDAP shall provide automated routines for conducting the following analyzer system diagnostic and verification functions. These routines shall provide for appropriate troubleshooting, quality control, reporting and data storage sub-functions.**

(a) **Checks of basic analyzer performance including detector condition, response, repeatability, and drift.**
(b) **NOx quench check System configuration, parameters backup & restore.**
(c) **CO2 interference check of CO analyzers.**
(d) **Determination of methane response of total hydrocarbon analyzer**
(e) **Determination of generalized HC species response of total hydrocarbon analyzer (single component). This is envisioned to be performed in a manner equivalent to the methane response determination.**
(f) **Determination/verification of measurements made in conjunction with dynamic correction parameters.**
(g) **Verification/calibration of pressure, flow, temperature and humidity measurement instrumentation**
(h) **Leak check routines. The leak check shall be based on vacuum decay utilizing a high-resolution transducer(s).**
(i) **Other routines required to ensure analyzer optimization and peak performance.**

2.5.61   Reserved

Data Analysis and Reporting Functions

2.5.62   TDAP shall provide functions to support the optimization and control of analysis quality, predictive maintenance of the Gas Laboratory Analysis System, gas stability checking and trend analysis.

2.5.63   During the analysis session, TDAP shall provide an interactive data analysis function. As part of this function, TDAP shall display the previous calibration coefficients, active calibration coefficients, known or nominal cylinder calibrations, analyzed cylinder concentrations and deviations of analyzed cylinder concentrations from known or nominal concentrations. Deviations shall be displayed and reported on both an absolute and percentage basis. In addition, TDAP shall display uncorrected concentration, or other measure of uncorrected detector output corrections, to concentrations and measurement results upon which corrections are made. TDAP shall further allow for including or excluding measurements from the calibration by means of a check box or similar display function. In this way, the operator may interactively alter the status or intended use of each measurement for the purpose of curve optimization and trouble shooting. This shall be allowable at any time up until the point that the analysis session is closed.

2.5.64   Reserved

2.5.65   TDAP shall provide a means for time series tracking of the level and variability of system checks and verifications, such means as Statistical Process Control. This function shall be a flexible analysis capability that can be easily configured to perform a variety of functions. The following are examples of this analysis function.

- **Plot of NOx efficiency**
- **Plot of the variability of multiple analyses of a cylinder during an analysis session to assess whether measurement variability is stable over time**

2.5.66   All automated analysis, calibration and verification functions shall include an option to produce a summary report of observations, corrections, intermediate and final data, notes and other relevant information deemed appropriate by the contractor based on its expertise and the design of its products.

2.5.67   For all reports, pertinent header information shall be presented on each page, sufficient to uniquely identify that each page is part of the same session report. All

report pages shall be labeled with the current page number and the total number of pages. All pages, of all reports, related to analysis sessions shall contain the analysis session number.

2.5.68 **All reports and computer records produced to document measurement instrument calibration/verification shall minimally contain the following information:**

    (a) **Name of operation, pertinent references**
    (b) **Date/Time of start/end of operation, Operator, Date/Time printed**
    (c) **EPA analyzer site designation**
    (d) **Identification of devices and standards utilized, including cylinders used to generate calibration curve and curve ID**
    (e) **Data related to pertinent conditions, such as pressure, temperature, humidity**
    (f) **All data directly related to the operation conducted**
    (g) **Summarized data related to outcome such as coefficients, offsets, efficiencies, both "as found" and "as calibrated," where applicable**
    (h) **Other pertinent statistics to indicate quality of outcome such as regressions statistics and other summary statistics**
    (i) **Text-type notes and observations**
    (j) **Pass/Fail indications and Accept or Reject indications, where applicable**
    (k) **Units identified for all data**

2.5.69 **Analyzer data shall be reported as raw uncorrected data alone and concentration based on the selected calibration data. Calibration data may be in the form of an existing curve or a curve established with standards analyzed concurrent with the analysis of unknowns. Corrected concentrations shall be reported as appropriate to the correction parameters selected either before or after the analysis. When corrected concentrations are reported they shall be reported along with uncorrected concentrations and any other data utilized to make the correction.**

2.5.70 **Reserved**

2.5.71 **Sample report content and requirements for certain computer displays may be found in Appendix G, "Standard Reports." All proposed report layouts and content shall be approved by the EPA Project Officer, as indicated in the Project Management Requirements.**

2.5.72 **Reserved**

Data Handling

2.5.73 Data collected by TDAP will ultimately be utilzed by EPA software and systems to support traceability analysis. TDAP shall acquire and make information available to support this down-stream documentation of traceability per the requirement of ISO 17025, and additional, specific requirements found in this Statement of Work. The traceability of gas analyses by EPA systems include both traceability of gas standards and the traceability of all other measurements used in the process of naming the concentration. EPA will at times require access to raw measurements as well as other factors use in the generation of corrections or adjustments to measurements used in the process of naming the concentration.

2.5.74 All data from each analysis session in which a given cylinder is utilized shall also be permanently associated with each cylinder in the retained data.

2.5.76 Reserved

2.5.77 The logged results shall retain maximal analysis information including raw measurements, the presence and magnitude of corrections applied to the readings or resulting concentration values, any measurements made in conjunction with any corrections and any other data required to independently, numerically reconstruct the final concentration value.

2.5.78 The EPA provided gas cylinder data base and other tools shall be utilized by the GLAS to provide alternatives to keyboard entry of data. This include gas cylinder id's, data base key field items, and gas concentrations. A barcode reader and/or software dropdown list boxes and similar tools shall facilitate identification of individual gas cylinders. Other entries into TDAP shall be by pull down menu, radio button, check box or default value whenever possible or as appropriate.

2.5.79 The TDAP shall make all acquired data available to the IFC using delimited ASCII files or other methods as identified in Appendix C and Appendix D.

2.5.80 The GLAS populates its gas cylinder data base files using the IFC provided gas cylinder data base file(s) provided to the TDAP by the IFC using methods and formats outlined in Appendix C and Appendix D.

2.5.81 All features of TDAP shall be readily adaptable for future expansion. At a minimum, the TDAP system shall provide for the straight-forward incorporation of four additional analyzers from any vendor. This extension will be performed by EPA staff with minimal requirement for additional support from the GLAS or analyzer vendor. The TDAP system must include drivers/protocols for communication with gas analyzers using the LONworks protocol (eg. Rosemont) and AK protocols (eg.

Pierburg, Signal, Horiba,). (See 2.1.7)

3.0 Other Support Equipment

3.0.1 The contractor shall supply, install and integrate an electronic hygrometer and dry-bulb temperature instrument, Vaisala® HMP 233 with remote display.

3.0.2 Rack mount cabinets, operator's console and other cabinetry, as required, shall be provided for all equipment delivered under this contract.

4.0 Documentation Requirements

4.0.1 The contractor shall provide complete as installed documentation for all equipment delivered under this contract, including wire lists, color coding, electrical schematics, piping/tubing diagrams, operating, maintenance and repair manuals, and computer system documentation.

4.0.2 A minimum of three sets of each document shall be provided and when available, the contractor shall also provide the documentation in computer readable user modifiable form. Microsoft Word, WordPerfect, AutoCADD, VectorWorks and Microsoft Excel are acceptable file formats as well as any that are compatible with standard translator/conversion tools provided by those applications. PDF files would also be suitable for certain documents that would be unlikely to need revision over time.

4.0.3 The contractor shall provide a recommended calibration, verification and preventative maintenance plan, which will detail calibration, verification and preventative maintenance procedures, schedules, and recommended spare parts inventory.

4.0.4 The contractor shall provide a listing of all system warning and alarm messages, with full explanation as to their exact meaning, impact and action required.

4.0.5 The contractor shall provide a complete "Lock-Out, Tag-Out" instruction for equipment requiring energy-isolating devices in accordance with the OSHA rule on the Control of Hazardous Energy (Lockout/Tagout) of Title 29 of the Code of Federal Regulations (29 CFR) Part 1910.147.

4.0.6   **The contractor shall provide complete documentation of the quality control features of the delivered systems, and instructions as to their maintenance and utilization. This documentation shall be sufficient to provide system documentation and instruction to satisfy the relevant requirements of ISO 17025 - General Requirements for the Competence of Testing and Calibration Laboratories**

4.0.7   **The contractor shall supply a list of consumable items with recommended supply sources, as well as a recommended spare parts list for routine maintenance operations along with a list of those parts and recommended supply sources.**

5.0   Acceptance Testing Requirements

5.0.1   **The contractor shall develop a comprehensive final acceptance plan, approved by EPA, which will efficiently verify that all requirements contained in this Statement of Work, and referenced documents, have been achieved in the delivered system(s). This verification will take place at the contractor's point of final assembly prior to delivery of the system to EPA. The contractor shall provide all gas standards for this testing. EPA expects off-site acceptance testing to be a demonstration of the ability and functionality of the TDAP and it components after development has been completed. EPA does not expect that absolute system accuracy will be demonstrated during this portion of the testing, therefore the accuracy requirement for gas standards is at the contractor's discretion.**

The contractor shall deliver a satisfactory acceptance plan to the EPA Project Officer at 30 days prior to the start of the acceptance process. Prior to commencement of acceptance testing, the EPA Project Officer must approve the acceptance plan, in writing. Once approved, the contractor shall provide the EPA Project Officer with a detailed schedule of acceptance activities at least 7 days in advance. At least 2 days in advance, the Project Officer will indicate which activities EPA personnel will observe.

5.0.2   **The measurement performance of each analytical instrument shall be checked as part of the acceptance test process. Performance shall be demonstrated for each range of each analyzer.**

5.0.3   **All computerized functions, including IFC interface functions, shall be tested as part of the acceptance process.**

5.0.4   **Once installed at NVFEL, the contractor shall repeat any testing required to confirm the correct operation, and demonstration of compliance with specifications, of the**

system after delivery. EPA expects on-site acceptance testing to demonstrate a fully functional GLAS and its ability to meet the requirements of the statement of work. Minimal or no further modification should be required once on-site acceptance testing has begun. In addition, the contractor shall conduct correlation testing with the existing EPA gas laboratory master bench for the following gases at a minimum of three levels each:

(a)   Total hydrocarbon (as propane)
(b)   Methane
(c)   Carbon dioxide
(d)   Carbon monoxide
(e)   NOx
(f)   Oxygen

Should any bias between the two systems be detected the contractor shall investigate the cause and rectify any errors that are shown to be due to the delivered system. If the contractor can demonstrate that the results from the delivered system establish a more representative concentration no further action to resolve any differences will be required. The measured value versus certified values of NIST SRMs shall be utilized as the final arbiter of any discrepancies between existing and delivered systems.

5.0.5   All acceptance testing shall be the responsibility of the contractor. The contractor, at the contractor's expense, shall rectify all non-compliant conditions. If repairs or changes are made, the contractor shall repeat acceptance testing to demonstrate the acceptable quality of the final product, to the extent necessitated by the scope of the repair or change. The contractor shall prepare a report for each phase of acceptance testing that clearly describes all the various tests and reviews conducted as part of the acceptance activity, the outcomes of those tests and a description of follow up actions, as required. Test reports shall be clearly cross referenced to the requirements of the Statement of Work and other significant performance details established during the technical interchange process.

5.0.6   EPA personnel shall observe the acceptance process. The EPA Project Officer may waive the opportunity to observe certain aspects of the acceptance process.

5.0.7   The acceptance plan shall be cross-referenced, section by section in a straightforward manner, to the requirements of this Statement of Work.   The plan shall be designed in such a manner as to also form the basis of a final acceptance report. The acceptance plan shall also address all other requirements deemed significant and appropriate by the contractor, based on the specific design and

configuration of their system and significant proprietary features.

5.0.8 **Upon completion of the off-site testing, the contractor shall deliver a preliminary acceptance report to EPA. This report shall provide documented evidence of compliance to the requirements of this Statement of Work and the Acceptance Plan, with content and format suitable for successful audit to ISO 17025 standards.**

5.0.9 **Acceptance tests shall statistically demonstrate compliance with the parametric requirements of this Statement of Work and applicable regulatory requirements, within stated levels of uncertainty.**

5.0.10 **Acceptance tests shall also demonstrate that immediately before shipping, the system is computer virus free. Once delivered, EPA will scan the delivered computer systems using its elaborate check-out procedures. This will be witnessed by the contractor before any connection is made to EPA computers or network systems. Virus scans will also be conducted before and after any system updates using removable media are made on-site to the TDAP during the performance of work under this contract. Infected computers and/or media will be returned to the contractor for resolution. At its discretion, EPA virus scans may be waived for non-Windows TDAP systems.**

6.0 Warranty

6.0.1 **The contractor shall warranty the performance and functionality of its products delivered under this contract for a minimum of one year after formal EPA acceptance and approval.**

6.0.2 **This warranty shall provide for cost-free repair or replacement of covered hardware and software. This warranty shall not reduce any requirement in this Statement of Work.**

7.0 Training

7.0.1 **At a minimum, the following training must be provided:**

(a) **Gas Laboratory Analysis and Traceability System familiarization at the time of installation, sufficient to enable the operator to operate the System, collect and store data, and print a report. This training is expected to be on the order of 2 days for up to 6 people.**

(b)   **Availability of contractor personnel for specific call-back training on site, with a minimum of 2 days additional training for up to 6 people.**

(c)   **A training course on the contractor's or component manufacturers' site that covers in-depth training on the System, software, and components. This training is expected to be on the order of 3 days for up to 4 people.**

8.0   Option Items

8.3   Option for Extended Service Contract

8.3.1   The contractor shall offer an option for an Extended Service Contract, renewable every year for a period of 4 years after the warranty period has expired.

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Figures

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Figures are available in a separate Acrobat file named: GLAS figures.pdf.

Appendices

Appendix A

Abbreviations and Terms

A/D	-	Analog-to-Digital
AFF	-	Above Finished Floor
C	-	Carbon (also C1), as methane
C3	-	Carbon, as propane
CARB	-	California Air Resources Board
CD	-	Compact Disc
CFH	-	Cubic Feet per Hour
CFM	-	Cubic Feet per Minute
CFO	-	Critical Flow Orifice
CFR	-	Code of Federal Regulations
CH4	-	Methane
CLD	-	Chemiluminescence Detector (NOx)
CO	-	Carbon Monoxide
CO2	-	Carbon Dioxide
COTS	-	Commercial Off-the-Shelf
CVar	-	Coefficient of Variation
DVD	-	Digital Video Disc
EPA	-	Environmental Protection Agency
FID	-	Flame Ionization Detector
FS	-	Full Scale
FSD	-	Full Scale Deflection
GC	-	Gas Chromatograph
GLAS	-	Gas Laboratory Analysis System
H2O	-	Water
HC	-	Hydrocarbon
HZ	-	Hertz (cycles per second)
ID	-	Identification
IEEE	-	Institute of Electrical and Electronic Engineers
IFC	-	InterFace Computer
I/O	-	Input/Output
ISO	-	International Standards Organization
L	-	Liters
LDV	-	Lowest Detectable Value
LNS	-	Laboratory Network System

MDL	**-**	**Minimum Detection Limit**
MFC	**-**	**Mass Flow Controller**
MSDS	**-**	**Material Safety Data Sheets**
N2	**-**	**Nitrogen**
N2O	**-**	**Nitrous Oxide**
NDIR	**-**	**Non Dispersive Infra Red**
NEC	**-**	**National Electrical Codes**
NEMA	**-**	**National Electrical Manufacturers Association**
NFPA	**-**	**National Fire Prevention Association**
NIST	**-**	**National Institute of Standards and Technology**
NL	**-**	**Nonlinearity**
NO	**-**	**Nitric Oxide**
NO2	**-**	**Nitrogen Dioxide**
NOx	**-**	**Oxides of Nitrogen**
NVFEL	**-**	**National Vehicle and Fuels Emissions Laboratory**
OSHA	**-**	**Occupational Safety and Health Administration**
PAS	**-**	**Photo-Acoustic Spectroscopy**
POC	**-**	**Point of Contact**
ppb	**-**	**Parts-per-billion**
ppm	**-**	**Parts-per-million**
PSIA	**-**	**Pounds per Square Inch Absolute**
PSIG	**-**	**Pounds per Square Inch Gauge**
QA/QC	**-**	**Quality Assurance / Quality Control**
RFP	**-**	**Request for Proposal**
SCFH	**-**	**Standard Cubic Feet per Hour**
SCFM	**-**	**Standard Cubic Feet per Minute**
SLPM	**-**	**Standard Liters Per Minute**
SOW	**-**	**Statement of Work**
SRM	**-**	**Standard Reference Material**
StdDev	**-**	**Standard Deviation (also STDEV)**
TDAP	**-**	**Test-control, Data Acquisition and Processing system**
TTL	**-**	**Transistor - Transistor Logic**
USB	**-**	**Universal Syncronous Bus**
VAC	**-**	**Voltage w/ Alternating Current**
VDC	**-**	**Voltage w/ Direct Current**

Appendix B

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Appendix C

Interface Computer (IFC)

The purpose of this appendix is to describe the interface requirements of the TDAP with the EPA supplied IFC.

EPA shall provide the IFC and its software. In 2002 the standard EPA IFC utilized the Windows NT 4.0 operating system. EPA-NVFEL expects, in 2003 through 2005 to complete migration away from the Windows NT 4.0 operating system to Windows 2000. Use of Windows XP, Linux/Unix and later version of Windows operating systems will be minimal. The IFC will adhere to the Appendix C1 NVFEL General Interface Guidelines and NVFEL Laboratory Network System requirements in Figure 1, except as described in the following sections.

1.   Configuration

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Pentium PC
Windows NT 4.0 or 2000

1.1   Software

Full installation of Microsoft Office 2000
Oracle Client Tools and Net 80

1.2   Communication Protocols

TCP/IP network protocol
NETBUI network protocol

1.3   Network Identification

1.3.1   Workgroup/Computer Name/Workgroup will be IFC/GLAS

2.   File Transfers Overview

2.1   Visual Basic File/Directory Commands will be used by IFC to interface with TDAP. The contractor shall ensure that Visual Basic software, executing on the IFC, is able

to control and supervise TDAP file and TDAP file-directory management utilizing disk drive, file directory and file management statements, summarized below.

2.2 **The EPA IFC computer programs will utilize Windows drive mounts or similar connections to enable Visual Basic applications to navigate directories and maintain files on the TDAP system disk drive. Hummingbird NFS Software and Samba Open Source Free Software has been utilized at some NVFEL test sites with Unix OS TDAPs to satisfy this requirement.**

2.3 **Specific Visual Basic Statements to be utilized by the IFC to push files to the TDAP and pull files from the TDAP include:**
>   **ChDir**
>   **ChDrive**
>   **RmDir**
>   **Dir**
>   **CurDir**
>   **Kill**
>   **Name**
>   **FileCopy**

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3. **TDAP/IFC During Analysis Sessions**

3.1 **Before Analysis Sessions - Visual Basic software running on the IFC files will control and supervise the transfer of files to established file directories on the TDAP. Such files will include configuration information, data base files and parameters necessary to conduct TDAP operations. EPA will be responsible to provide all IFC software.**

3.2 **Analysis Sessions Operations - There shall be no TDAP requirements or dependencies for interaction with the IFC and any LNS components during analysis sessions. TDAP shall be immune to LNS and IFC network traffic. An EPA-NVFEL network switch shall ensure isolation of the TDAP from non-TDAP network traffic. EPA will be responsible to provide all IFC software.**

3.3 **After Analysis Sessions - Visual Basic software running on the IFC files will control and supervise the transfer of files from established file directories on the TDAP to the IFC and LNS computers. Visual Basic software running on the IFC files will control and supervise the cleanup of files and established file directories on the TDAP. Such files will include data base files or text formatted data base update**

transactions files. EPA will be responsible to provide all IFC software.

4. TDAP/IFC During Calibration and Maintenance Operations

4.1 During system instrumentation calibration and maintenance procedures - there shall be no interaction with the IFC and any LNS components.

4.2 After Calibration and Maintenance Procedures - Visual Basic software running on the IFC files will control and supervise the transfer of files from established file directories on the TDAP to the IFC and LNS computers. Visual Basic software running on the IFC files will control and supervise the cleanup of files and established file directories on the TDAP. Such files will include data base files or text formatted data base update transactions files. EPA will be responsible to provide all IFC software.

5.0 File Formats

5.1 Pre Analysis Session Variable names, Formats and Definitions

5.1.1 Files shall be formatted according to the General Interface Guidelines in Appendix D. Additional instructions regarding gas cylinder data base file(s) are in Appendix E.

5.1.2 Specific file formats for data exchanges between TDAP and IFC are negotiable, but must be approved, in advance, by the EPA Project Officer.

5.2 Post-Analysis Session Variable names, Formats and Definitions

5.2.1. The format of these files shall follow the general interface guidance in Appendix D.

5.2.2 The specific file format is negotiable, but must be approved, in advance, by the EPA Project Officer.

5.3 Calibration and Maintenance Variable Names, Formats and Definitions

5.3.1 The format of these files shall follow the general interface guidance in Appendix D.

5.3.2 Specific file formats for data exchanges between TDAP and IFC are negotiable, but must be approved, in advance, by the EPA Project Officer.

Appendix D

General Interface Guidelines

The purpose of this appendix is to provide guidance in the absence of other specific guidance in this and other EPA NVFEL Statements of Work. Several of the files included in section 1.6 of this Appendix may be irrelevant to this GLAS Statement of Work but are included for information purposes only.

1.0   General Site Interface & File Formats

1.1   Network Requirements

1.1.1   The TDAP computer system shall be compliant with EPA-NVFEL network requirements.

1.2   Communication Protocol

1.2.1   The TDAP computer system shall be compliant with EPA-NVFEL communication protocol requirements.

1.3   File Transfer

1.3.1   All files created by the site computer system shall be transferable in a batch file selection and transfer mode. File transfers shall not be restricted to interactive file selection or to a single file transfer. All files shall be transferable via network interface and via removable storage media. File transfers shall not be restricted to proprietary methods or formats and shall use Commercial-Off-The-Shelf (COTS) software wherever possible.

1.4   File Format

Standard ASCII Formats (SAF) shall be used wherever available for files created by or sent to the site computer systems. Delimited ASCII Formats (DAF) shall be used for files created by or sent to the site computer system in all cases where SAFs are not available. For DAFs, the field names shall appear on the first line, data types shall appear on the second line, engineering units shall appear on the third line, and the field values shall appear on the fourth line and below. More specific DAF requirements appear in Sections 1.4.1 through 1.4.7.

1.4.1   The field names shall appear on the first line and the field types, engineering units

values shall appear on lines two and below.

1.4.2   **Dates shall be in "mm/dd/yyyy" formats. Time shall be in "hh:mm:ss" formats.**

1.4.3   **Real numbers, except for whole numbers, shall be in exponential (ñ.nnnnnnEñnn) formats.**

1.4.4   **Values that are not applicable for a particular field shall be filled in with a missing data code value of "-9.999E-99" for real numbers and "99" for characters.**

1.4.5   **Field names shall not contain embedded blanks; instead, underscores may be used to delimit.**

1.4.6   **Numeric data shall be right-justified and character data shall be left-justified.**

1.4.7   **The test report number shall follow the site computer naming convention. Export files containing data that synchronize with site computer data shall use the site computer test report number for identification.**

1.5   **Ease of File Editing and Installation**

1.5.1   **The site computer system shall be able to accept, validate, and use files that have been prepared or edited on external computer systems without further modifications. Installation of files shall be accomplished through a common user-friendly graphic interface rather than through cryptic installation procedures involving the typing of operating system commands or navigating through disk-drive, directory and file icons.**

1.6   **File Description**

    Information and format specifications for files that are created by or sent to the site computer system appear in Sections 1.6.1 to 1.6.15. For other files not described here, either SAFs or DAFs are required per Section 1.4.

1.6.1   **Test Site Configuration Files**

    Test site configuration files shall identify the major site components in use, model information, software versions, and parameters that may be useful to emissions test site instrumentation, including the site computer system.

    No standard format currently exists; therefore, either SAFs or DAFs are required

per Section 1.4.

1.6.2   Site and Instrumentation Options Selection and Control Parameters Files

Files that include the option selections and any control parameters shall contain all user selections and all modifiable site/instrumentation parameters that control site performance aspects.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.3   Test Sequence Control Schedules and Parameters Files

Test procedure parameters shall describe the test time events (e.g., startup and shutdown methods) corresponding to the analog/digital signal values.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.4   Acquired Hertz Data Files

Acquired Hertz data files contain recorded analog or digital values gathered at specific frequencies during tests. Data recorded at different frequencies will require separate files. The format for acquired Hertz data files shall be DAF with one data field per column and corresponding field names in the first row.

1.6.5   Acquired Non-Hertz Data Files

Acquired non-Hertz data files contain data not recorded at steady frequencies during tests.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.6   Input File Validation Reports

The site computer shall be able to accept, validate, and use files that have been prepared by external systems. If the file is not usable, the site computer shall generate a file validation report clearly identifying conflicts, as well as all formatting and content errors in the file.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.7   Data Analysis Report Files

Test-time and post-test data analysis reports shall contain any analyses performed by the site computer on data collected during a test.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.8   Event Log Files

All significant events should be identified, logged, time-stamped with clock time plus other relevant time stamps. GLAS event logs may include session event logs and gas analysis read sequence event logs. Significant events include (but are not limited to) system power-up, reset, initiation and termination of setup and analysis session events. Other events include ready to analyze conditions, gas analysis to obtain curve data points, analysis to determine gas concentration of known or unknown cylinders, cylinder identification, other gas analysis such as zero or span, control events, operator interventions, beginning and ending of emergency shutdowns and other safety events.

No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.

1.6.9   Data Base Files

Data Base Files contain tables.   EPA laboratory gas cylinder data base table(s) are described in Appendix E.   No standard format currently exists; therefore, either SAFs of DAFs are required per Section 1.4.   Alternatively, Gas Cylinder Inventory Data Base may be transferred in the format of Microsoft Access data base files or as negotiated between EPA and contractor. See Appendix E.

Appendix E

Data Dictionary

The following is information that defines and describes data items and tables used in the LNS Gas Cylinder Inventory Database. This list is provided for information purposes only. The intent is to familiarize vendors with nomenclature commonly used at NVFEL. Specific structure of databases and tables shall be established during the technical interchange process after contract award.

LNS Gas Cylinder Inventory Database

DATA ITEMS:

Cylinder identifier

The unique cylinder identifier is the Cylinder ID which includes a prefix plus LNS assigned unique sequence number. The prefix is based upon intended use, and employs the following letter codes:

G	NVFEL primary standard, typically a gravimetric blend
S	NVFEL secondary standard
W	NVFEL working gas
WS	Designated as a working gas with same quality as secondary standard
N	NIST SRM or equivalent, establishes NIST traceability
O	Other
Z	Ultra-pure zero gas
C1	Check sample single component + diluent
C2	Check sample two component + diluent
C3	Check sample three component + diluent
C4	Check sample four component + diluent
U	Utility gas

Cylinder serial number

Cylinder serial number is typically the number stamped, or otherwise permanently affixed to a cylinder. This number alone can not be used to uniquely identify the contents of a cylinder, since cylinders can usually be reused.

Cylinder size (water volume)
Volume Units (l, gal)
Date Received

Date Removed
Entry_Timestamp
> **Time stamp yyyy/mm/dd hh:mm:ss for entry of this record into the cylinder database**

Effective_Timestamp
> **Time stamp yyyy/mm/dd hh:mm:ss for a human decision that this record in the cylinder database is the most recent, useful or active record for this gas cylinder.**

Ineffective_Timestamp
> **Time stamp yyyy/mm/dd hh:mm:ss for a human decision that this record is no longer the most recent, useful, or active record for this gas cylinder in the cylinder database.**

Active_Key
> **No, this record is no longer useful or active**
> **Raw, this record may become identified as useful or active pending a human decision or completion of computer program data processing.**
> **Yes, this record is useful or active**

Status
> **On order**
> **In house, not made active**
> **Removed from service**
> **Removed from service reason**
> **Active status, ok for highest use designation**
> **Status change date**
> **Status change date operator**

Number of principle constituents (1-4)
Minor_Gas or principal constituent(s)
> **HC, CO, CO2, NOx, NO2, , NO, O2, CH4, Methane, Air, He, C3H8, N2**

Diluent (Nitrogen, helium, air, etc.)
Concentration Units
> **(Pct, ppm, ppmC)**

Nominal concentration (per principle constituent)
Named concentration (per principle constituent)
Named concentration date (per principle constituent)
Named concentration source (NVFEL Gas Laboratory, Gas Supplier, NIST, Other (enter text) (per principle constituent))
Named concentration uncertainty (per each analyte)
Cylinder note field

TABLES:

The following table descriptions illustrate the tables and collections of data now in use in the

NVFEL laboratory or envisioned as the result of this contractual work effort.

Analyzer_Assignment

> **The analyzer site assignment table historically tracks the placement of individual gas analyzers to discrete groups of analyzers, called "analyzer sites", at various locations in the NVFEL laboratory.**

Unit_Calibration

> **The unit calibration table historically tracks the calibration curves derived for laboratory instrumentation, including gas analyzers. Gas laboratory master bench analyzer curves are not tracked in this table.**

Session_Readings

> **The session readings tables and files are used to collect gas analysis session values and information used to derive gas cylinder concentrations and label information.**

Session_Event_Log

> **The session event log tables and files are used to collect and log the individual steps and unusual events that occur during gas analysis sessions.**

Cylinder_Inventory

> **The cylinder inventory tables historically track individual gas cylinders in the NVFEL laboratory by cylinder ID. Key fields link this table with related information in other cylinder tables.**

Cylinder_Name

> **The cylinder name table historically tracks the individual gas cylinder gas concentration values, or names, determined by the gas laboratory analysis system. Key fields link this table with related information in other cylinder tables.**

Cylinder_Status

> **The cylinder status table historically tracks the useful status of individual gas cylinders. Key fields link this table with related information in other cylinder tables.**

Cylinder_Assignment

> **The cylinder assignment table historically tracks the placement of individual gas analyzers to discrete groups of gas cylinders at various locations, called "cylinder sites", in the NVFEL laboratory.**

Appendix F

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Appendix G

<u>Standard Reports, Labels, Tags</u>

The following outlines nominal requirements for standardized reports and labels. Additional reports shall be easy to create and all reports shall be readily modifiable through a report generator/editor or similar automated tool provided as part of the delivered system. Certain criteria apply to all reports, others apply to only certain reports or report sections. Specific report layouts shall be determined during the technical interchange phase of the contractor.

I.   Standardized Reports

<u>Report Headers</u>

- **"United States Environmental Protection Agency"**
- **"NVFEL Gas Standards Laboratory"**
- **Appropriate report title appropriate to content**
- **Operation start date/time (as appropriate)**
- **Operation end date/time (as appropriate)**
- **Report generation date/time**
- **Analyzer site identification (to be determined)**
- **Analyst**
- **Analysis session identification (as applicable)**

<u>Report Footer</u>

- **Page number**
- **Total number of pages**
- **Printed date/time**
- **System name, software version**

<u>Report - Main Body</u>

- **"Report of Analysis" - Analysis session summary**
  - **Session closed date time**
  - **Constituent analyzed**
  - **Diluent**
  - **Concentration unit**
  - **Nominal range**
  - **Curve Related Data**
    - **Regression type**

- **Curve fit order**
- **Curve coefficient**
- **Forced zero indication**
- **Curve weighting**
- **Number of calibration points**
- **Standard regression statistics**
- **Percent non-linearity**

- **Per Analysis Data**
  - **NVFEL Cylinder ID of unknown**
  - **Results of the analysis of standards, traceable reference materials and other quality control materials**
    - **Official concentration, measured concentration, and NVFEL cylinder ID of all cylinders used to generate the active curve (if multiple analyses average, standard deviation and uncertainty estimate)**
    - **Official concentration, measured concentration, and NVFEL cylinder ID of any additional cylinders measured for quality control purposes**
    - **Offset from official concentration (absolute and percentage)**
  - **Results of the analysis of unknowns**
    - **Nominal concentration**
    - **Final concentration result based on current calibration curve (if multiple analyses average, standard deviation and uncertainty estimate)**
    - **Offset from nominal concentration (absolute and percentage)**

- **Analysis Detail Page(s)**
  - **Analysis plot showing final curve and all individual final concentrations**
  - **"Raw", uncorrected results**
    - **Shown in units that would feed into shown calibration curve**
    - **Shown in uncorrected concentration based on final calibration curve**
  - **Corrections, shown in concentration units, magnitude based on concentration curve**
  - **Final corrected concentration**
  - **Instrument gas pressures and flows**
  - **Ambient temperature, barometer**
  - **Other measurement results that any corrections were based upon**
- **Comments**

- **"Auxiliary Instrument Calibration Report"**
  - **As found calibration coefficients/responses to standard inputs**
  - **As calibrated calibration coefficients/responses to standard inputs**
  - **Offsets - as found vs as calibrated**
  - **Identification of any standards and/or special devices used for the calibration**

- **"Event Log Report"**
  - **An event log report shall be available to show all events that occurred within a specific time frame, including warnings or alarms issues.**

II.   **Gas Cylinder Labels and Tags**

EPA NVFEL Gas Laboratory Traceability system software will utilized GLAS acquired information to help prepare, print and track the following Gas Cylinder Labels and Inventory Tags. The GLAS contributes to this information but does <u>not</u> prepare or print labels and tags. The information below is what is contained now on gas standards cylinders.

<u>Gas Cylinder Labels</u>
- **"United States Environmental Protection Agency"**
- **"NVFEL Gas Standards Laboratory"**
- **Official EPA logo (this will be provided by EPA as jpeg or other graphics file)**
- **Cylinder identification and barcode**
- **Cylinder serial number (nominally this will be the permanently stamped number on the cylinder and is different from the cylinder identification)**
- **Cylinder volume**
- **Cylinder gas constituents**
  - **Analyte(s)**
  - **Diluent**
- **Official concentration(s)**
- **Traceability designator**
- **Date of determination**
- **Laboratory**
- **Analysis session identification (if analyzed at EPA)**
- **Cylinder pressure at time of analysis**
- **Expiration Date**
- **Highest use code**

<u>Gas Cylinder Inventory Tags</u>

- **The inventory tag shall nominally be 4" x 9" card stock with a reinforced punched hole at the top and divided by perforation into 3 portions (2 tear offs)**

- **Top section shall include:**
  - **"United States Environmental Protection Agency"**
  - **"NVFEL Gas Standards Laboratory"**
  - **Official EPA logo (this will be provided by EPA as jpeg or other graphics file)**
  - **Cylinder identification and barcode**
  - **Cylinder serial number (nominally this will be the permanently stamped number on the cylinder and is different from the cylinder identification)**
  - **Cylinder volume**
  - **Cylinder gas constituents**
    - **Analyte(s)**
    - **Diluent**
  - **Official concentration(s)**
  - **Expiration Date**
  - **Highest use code**

- **Middle "Please reorder" section**
  - **Cylinder identification and barcode**
  - **Cylinder volume**
  - **Cylinder gas constituents**
    - **Analyte(s)**
    - **Diluent**
  - **Official concentration(s)**
  - **Expiration Date**
  - **Highest use code**
  - **Blank space for date**
  - **Blank space for name**
  - **Blank space for last observed pressure**

- **Bottom "Location assignment" section**
  - **Cylinder identification and barcode**
  - **Cylinder volume**
  - **Cylinder gas constituents**
    - **Analyte(s)**
    - **Diluent**
  - **Official concentration(s)**
  - **Expiration Date**
  - **Highest use code**
  - **Blank space for date**
  - **Blank space for name**
  - **Blank space for location**

Appendix H

<u>Schedule of Deliverables</u>

Dates shown are nominal completion deadlines relative to the contract award date. Where dates are not shown, the contractor shall propose appropriate dates at the Project Kickoff Meeting. All days are calendar days. All Technical Interchange Meetings (TIMs) are to be held at EPA-NVFEL. Video conferencing will be an acceptable alternative for some meetings. The contractor or EPA, as needed, may schedule TIMs. The project calendar shall factor in adequate time to review materials in advance of TIMS. Incentives/penalties are provided for early/late completion of certain critical phases.

<u>Gas Laboratory Analysis System</u>

Project Kickoff Meeting and Site Survey at EPA-NVFEL (30 days)

Submission of Project Management Plan TIM
- **Project Programming or Methodology**
- **Project Management Schedule for key events and milestones (e.g., MS Project)**
- **Schedule/Triggers for Technical Exchange Meetings and Approvals**
- **Quality Assurance**
- **Schedule for Status Reports**
- **Open Item Tracking**

Final Submission of Project Management Plan (50 days)
EPA Project Management Plan Review (no more than 5 days after submission)

Begin Bi-Weekly Status Reports/Open Item Tracking Submission (Starting after project kickoff)

Submission of Preliminary Design (70 days)
- **Equipment design and layout, functional specifications**
- **Before/After Analysis Session content and format of transferred files**

Preliminary Design Review TIM (75 days)
EPA Preliminary Design Review (no more than 7 days after submission)

Submission of Final Physical Design for Approval (90 days)   *Incentive/Penalty point*

Submission of Documents for Review
- **Report Layouts**

- Pretest Data Entry and Session Set-Up Screens
- Calculation Verifications

Documents Review TIM (5 days after submission)
EPA Documents Review (no more than 7 days after submission)

Submission of Proposed Acceptance Plan (100 days)
Final Design Review and Proposed Acceptance Plan Review TIM
Submission of Final Acceptance Plan (115 days)
EPA Acceptance Plan Review (no more than 7 days after submission)

Submission of Calibration Reports and Measurement Traceability Documentation

Submission of Installation Material Safety Data Information to EPA for Approval

Submission of Contractor-Site Acceptance Dates to EPA

System functionality demonstrated (180 days)

Contractor-Site Acceptance Testing Completed (190 days)   *Incentive/Penalty point*
Submission of Summary Report of Contractor-Site Acceptance Results (195 days)

Equipment Delivery Date Confirmation to EPA (7 days in advance of shipment)

EPA Authorization to Ship (10 days after receipt of Acceptance Report demonstrating all criteria met)

EPA-Provided Contractor Safety Training
Delivery of all equipment to EPA (220 days)

Equipment Installation (250 days)   *Incentive/Penalty point*

Final Acceptance Testing Completed (305 days)
-        **Performance test must meet specs on each instrument**

Training and Submission of all Documentation (320 days)   *Incentive/Penalty point*
-        **Calibration, verification, and maintenance**
-        **List of proprietary messages, if any**
-        **Lock-out / Tag-out instructions**
-        **Quality Control features**
-        **List of Consumables**

Final EPA Approval

DRAFT